

## PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

**PCT****NOTIFICATION OF ELECTION**

(PCT Rule 61.2)

Date of mailing (day/month/year) 18 June 2001 (18.06.01)	To:  Commissioner US Department of Commerce United States Patent and Trademark Office, PCT 2011 South Clark Place Room CP2/5C24 Arlington, VA 22202 ETATS-UNIS D'AMERIQUE  in its capacity as elected Office
International application No. PCT/FI00/00834	Applicant's or agent's file reference 992097 WO
International filing date (day/month/year) 29 September 2000 (29.09.00)	Priority date (day/month/year) 30 September 1999 (30.09.99)
Applicant  LILJA, Launo et al	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

03 April 2001 (03.04.01)

in a notice effecting later election filed with the International Bureau on:

\_\_\_\_\_

2. The election  was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer  Nestor Santesso  Telephone No.: (41-22) 338.83.38
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## PATENT COOPERATION TREATY

PCT

## NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

**OUTOKUMPU OYJ**  
 Intellectual Property Management  
 P.O. Box 27  
 FIN-02201 Espoo  
 FINLANDE

**(TOKUMPU Oyj**  
 IPM

17.04.2001

Received

<b>Date of mailing (day/month/year)</b> 05 April 2001 (05.04.01)			
<b>Applicant's or agent's file reference</b> 992097 WO		<b>IMPORTANT NOTICE</b>	
<b>International application No.</b> PCT/FI00/00834	<b>International filing date (day/month/year)</b> 29 September 2000 (29.09.00)	<b>Priority date (day/month/year)</b> 30 September 1999 (30.09.99)	
<b>Applicant</b> OUTOKUMPU OYJ et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:  
**AU,KP,KR,US**

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:  
**AE,AL,AM,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CN,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,NO,NZ,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW**  
 The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).
3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 05 April 2001 (05.04.01) under No. WO 01/23071

**REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)**

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

**REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))**

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer  J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

REC'D 23 JAN 2002	
WIPO	PCT

(PCT Article 36 and Rule 70)

12

Applicant's or agent's file reference 992097 WO	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/FI00/00834	International filing date ( <i>day/month/year</i> ) 29.09.2000	Priority date ( <i>day/month/year</i> ) 30.09.1999
International Patent Classification (IPC) or national classification and IPC7 B 01 D 47/02		
<p>Applicant Outokumpu Oyj et al</p>		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>4</u> sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of <u>3</u> sheets.</p> <p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the report</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input type="checkbox"/> Certain defects in the international application</li> <li>VIII <input type="checkbox"/> Certain observations on the international application</li> </ul>
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Date of submission of the demand 03.04.2001	Date of completion of this report 10.01.2002
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Marianne Bratsberg/ELY Telephone No. 08-782 25 00

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00834

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

 the international application as originally filed the description:

pages 1-8 , as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

 the claims:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, as amended (together with any statement) under article 19

pages \_\_\_\_\_, filed with the demand

pages 9-11 , filed with the letter of 09.01.2002

 the drawings:

pages 1-8 , as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

 the sequence listing part of the description:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

 the language of a translation furnished for the purposes of international search (under Rule 23.1(b)). the language of publication of the international application (under Rule 48.3(b)). the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

 contained in the international application in written form. filed together with the international application in computer readable form. furnished subsequently to this Authority in written form. furnished subsequently to this Authority in computer readable form. The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished. The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4.  The amendments have resulted in the cancellation of: the description, pages \_\_\_\_\_ the claims, Nos. \_\_\_\_\_ the drawings, sheet/fig \_\_\_\_\_5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00834

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

## 1. Statement

Novelty (N)	Claims 1-14	YES
	Claims	NO
Inventive step (IS)	Claims 1-14	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-14	YES
	Claims	NO

## 2. Citations and explanations (Rule 70.7)

This report is based upon the amended claims filed 09-01-2002.

The features of the originally filed claim 5 has been incorporated in the amended claim 1. Those features are that the cascade tubes are placed in an annular outer chamber surrounding said tubes, where the separate gas flows coming from each cascade tube are recombined.

Most relevant document cited in the International Search Report:

D1: US 5178653 A

It is noted by way of introduction in D1 that in order to prevent bulky constructions in gas scrubbers, an ideal solution is to use a combined scrubber and droplet separator unit (refer to column 1, line 25-33). The scrubber disclosed in D1 is of such a combined type. In contrast with scrubbers where a separate ready-made filter serves as droplet separator (refer to column 1, line 22-24), the scrubber according to D1 has a droplet separation unit designed in such a way that it can be combined with the scrubber unit into a compact apparatus (refer to fig. 1, 3a and 6b).

In this known scrubber, the gas or gases to be scrubbed are conducted into at least three vertical scrubbing tubes (1), and thereafter into a droplet separator formed of several nested cylinders, where the separate gas flows are recombined and forced in a rotary motion and the pure and droplet-free gas is discharged through a discharge tube (11) located in the middle of the scrubbing tubes.

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**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

The invention according to the amended claim 1 is novel with respect to the scrubber disclosed in D1. One difference is that the scrubbing tubes are of the cascade type and not of the venturi type. Further, in the scrubber according to the amended claim 1, the scrubbing tubes are placed in an annular outer chamber where the separate gas flows are recombined. This is not the case in D1, where the scrubbing tubes are placed in separate chambers (denoted 4 in fig. 3a) and the separate gas flows are recombined in an inner swirl chamber (denoted 7 in fig. 3a).

It is not considered obvious for a person skilled in the art to modify the scrubber in D1 in such a way as to arrive at the invention disclosed in the amended claim 1. This is because the modifications necessary therefor, namely the addition of an annular chamber, in which the gas flows recombine before they enter the droplet separator, go beyond what can be expected from the person skilled in the art.

Thus, the features through which the claimed invention differs from D1 solve the problem of accomplishing a new construction for a gas scrubber with combined scrubber and droplet separation units. The invention according to the amended claims 1-14 is therefore considered to involve an inventive step. It is also considered to be industrially applicable.

**PATENT CLAIMS**

1. A cascade scrubber (10) for scrubbing exhaust gas, whereby the scrubber contains several cascade tubes (12) for scrubbing gas, an inlet channel (9) for conveying the gas to the scrubber, a discharge tube (11) for venting the gas from the scrubber and a liquid tank for scrubbing the gas, **characterized in that** a gas scrubbing unit and a droplet separation unit are combined in the scrubber (10) into a compact apparatus, made up of several nested chambers (20, 22, 24, 16).  
5
2. A cascade scrubber according to patent claim 1, **characterized in that** a integrated gas distribution chamber (15) is placed in the upper section of the scrubber, and is connected to cascade tubes (12) in order to distribute the gas from the chamber to the cascade tubes.  
10
3. A cascade scrubber according to patent claim 2, **characterized in that** the gas distribution chamber (15) surrounds the gas discharge tube (11).  
15
4. A cascade scrubber according to patent claim 2, **characterized in that** a bottom (28) of the gas distribution chamber (15) is inclined so that the cross-sectional area of the chamber reduces as the distance from the inlet channel (9) increases.  
20
5. A cascade scrubber according to patent claim 1, **characterized in that** the cascade tubes (12) are placed in an annular outer chamber (20) surrounding them, where the separate gas flows coming from each cascade tube are recombined.  
25
6. A cascade scrubber according to patent claim 5, **characterized in that** the cross-sectional area of the upper section of the outer chamber (20) is smaller than that of the lower section.  
30

7. A cascade scrubber according to patent claim 5, characterized in that the outer chamber (20) is connected to another annular chamber (22) with the aid of at least partially tangentially positioned partitions (23).

5

8. A cascade scrubber according to patent claim 7, characterized in that the partitions (23) divide said annular chamber (22) into segments (24), the number of which is advantageously at most half the number of the cascade tubes (12).

10

9. A cascade scrubber according to patent claim 7, characterized in that the annular chamber (22) containing the partitions (23) is positioned inside the outer chamber (20).

15

10. A cascade scrubber according to patent claim 7, characterized in that the cross-sectional area of the upper section of the annular chamber (22) is greater than that of the lower section of the chamber.

20

11. A cascade scrubber according to patent claim 7, characterized in that at least two more nested chambers (25,16) forming the droplet separation unit of the scrubber are positioned inside the chamber (22) containing tangential partitions (23).

25

12. A cascade scrubber according to patent claim 1, characterized in that the innermost chamber (16) of the droplet separation unit is equipped at the liquid surface (14) with a swirl cone (26) narrowing towards the top.

30

13. A cascade scrubber according to patent claim 1, characterized in that the innermost chamber (16) of the droplet separation unit is connected to the discharge tube (11) of pure, dry gas.

**14. A cascade scrubber according to patent claim 1, characterized in that the equipment functions in a reduced pressure.**

**15. A cascade scrubber according to patent claim 1, characterized in that**  
5      **the scrubber is essentially cylindrical at the gas scrubbing unit and droplet separation unit and conical at the lower section.**

**PATENT COOPERATION TREATY**

**PCT**

**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 992097 WO	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/FI00/00834	International filing date ( <i>day/month/year</i> ) 29.09.2000	Priority date ( <i>day/month/year</i> ) 30.09.1999	
International Patent Classification (IPC) or national classification and IPC7 B 01 D 47/02			
<b>Applicant</b> Outokumpu Oyj et al			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I  Basis of the report
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand  03.04.2001	Date of completion of this report  10.01.2002	
Name and mailing address of the IPEA/SE  Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM  Facsimile No. 08-667 72 88	Telex 17978 PATOREG-S	Authorized officer  Marianne Bratsberg/ELY Telephone No. 08-782 25 00

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00834

## I. Basis of the report

1. With regard to the elements of the international application:<sup>\*</sup> the international application as originally filed the description:

pages 1-8 \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

 the claims:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, as amended (together with any statement) under article 19

pages \_\_\_\_\_, filed with the demand

pages 9-11 \_\_\_\_\_, filed with the letter of 09.01.2002

 the drawings:

pages 1-8 \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

 the sequence listing part of the description:

pages \_\_\_\_\_, as originally filed

pages \_\_\_\_\_, filed with the demand

pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

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 contained in the international application in written form. filed together with the international application in computer readable form. furnished subsequently to this Authority in written form. furnished subsequently to this Authority in computer readable form. The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished. The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4.  The amendments have resulted in the cancellation of: the description, pages \_\_\_\_\_ the claims, Nos. \_\_\_\_\_ the drawings, sheet/fig \_\_\_\_\_5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).<sup>\*\*</sup>

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00834

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

## 1. Statement

Novelty (N)	Claims	<u>1-14</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	<u>1-14</u>	YES
	Claims	_____	NO
Industrial applicability (IA)	Claims	<u>1-14</u>	YES
	Claims	_____	NO

## 2. Citations and explanations (Rule 70.7)

This report is based upon the amended claims filed 09-01-2002.

The features of the originally filed claim 5 has been incorporated in the amended claim 1. Those features are that the cascade tubes are placed in an annular outer chamber surrounding said tubes, where the separate gas flows coming from each cascade tube are recombined.

Most relevant document cited in the International Search Report:

D1: US 5178653 A

It is noted by way of introduction in D1 that in order to prevent bulky constructions in gas scrubbers, an ideal solution is to use a combined scrubber and droplet separator unit (refer to column 1, line 25-33). The scrubber disclosed in D1 is of such a combined type. In contrast with scrubbers where a separate ready-made filter serves as droplet separator (refer to column 1, line 22-24), the scrubber according to D1 has a droplet separation unit designed in such a way that it can be combined with the scrubber unit into a compact apparatus (refer to fig. 1, 3a and 6b).

In this known scrubber, the gas or gases to be scrubbed are conducted into at least three vertical scrubbing tubes (1), and thereafter into a droplet separator formed of several nested cylinders, where the separate gas flows are recombined and forced in a rotary motion and the pure and droplet-free gas is discharged through a discharge tube (11) located in the middle of the scrubbing tubes.

..../....

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

The invention according to the amended claim 1 is novel with respect to the scrubber disclosed in D1. One difference is that the scrubbing tubes are of the cascade type and not of the venturi type. Further, in the scrubber according to the amended claim 1, the scrubbing tubes are placed in an annular outer chamber where the separate gas flows are recombined. This is not the case in D1, where the scrubbing tubes are placed in separate chambers (denoted 4 in fig. 3a) and the separate gas flows are recombined in an inner swirl chamber (denoted 7 in fig. 3a).

It is not considered obvious for a person skilled in the art to modify the scrubber in D1 in such a way as to arrive at the invention disclosed in the amended claim 1. This is because the modifications necessary therefor, namely the addition of an annular chamber, in which the gas flows recombine before they enter the droplet separator, go beyond what can be expected from the person skilled in the art.

Thus, the features through which the claimed invention differs from D1 solve the problem of accomplishing a new construction for a gas scrubber with combined scrubber and droplet separation units. The invention according to the amended claims 1-14 is therefore considered to involve an inventive step. It is also considered to be industrially applicable.

09-01-2002

PATENT CLAIMS

1. A cascade scrubber (10) for scrubbing exhaust gas, whereby the scrubber contains several cascade tubes (12) for scrubbing gas, an inlet channel (9) for conveying the gas to the scrubber, a discharge tube (11) for venting the gas from the scrubber and a liquid tank for scrubbing the gas, **characterized in that** a gas scrubbing unit and a droplet separation unit are combined in the scrubber (10) into a compact apparatus, made up of several nested chambers (20, 22, 24, 16), and that the cascade tubes (12) are placed in an annular outer chamber (20) surrounding said tubes, where the separate gas flows coming from each cascade tube are recombined.
- 15 2. A cascade scrubber according to patent claim 1, **characterized in that** a integrated gas distribution chamber (15) is placed in the upper section of the scrubber, and is connected to cascade tubes (12) in order to distribute the gas from the chamber to the cascade tubes.
- 20 3. A cascade scrubber according to patent claim 2, **characterized in that** the gas distribution chamber (15) surrounds the gas discharge tube (11).
- 25 4. A cascade scrubber according to patent claim 2, **characterized in that** a bottom (28) of the gas distribution chamber (15) is inclined so that the cross-sectional area of the chamber reduces as the distance from the inlet channel (9) increases.
- 30 5. A cascade scrubber according to patent claim 5, **characterized in that** the cross-sectional area of the upper section of the outer chamber (20) is smaller than that of the lower section.

09-01-2002

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6. A cascade scrubber according to patent claim 5, **characterized in that** the outer chamber (20) is connected to another annular chamber (22) with the aid of at least partially tangentially positioned partitions (23).
- 5 7. A cascade scrubber according to patent claim 7, **characterized in that** the partitions (23) divide said annular chamber (22) into segments (24), the number of which is advantageously at most half the number of the cascade tubes (12).
- 10 8. A cascade scrubber according to patent claim 7, **characterized in that** the annular chamber (22) containing the partitions (23) is positioned inside the outer chamber (20).
- 15 9. A cascade scrubber according to patent claim 7, **characterized in that** the cross-sectional area of the upper section of the annular chamber (22) is greater than that of the lower section of the chamber.
- 20 10. A cascade scrubber according to patent claim 7, **characterized in that** at least two more nested chambers (25,16) forming the droplet separation unit of the scrubber are positioned inside the chamber (22) containing tangential partitions (23).
- 25 11. A cascade scrubber according to patent claim 1, **characterized in that** the innermost chamber (16) of the droplet separation unit is equipped at the liquid surface (14) with a swirl cone (26) narrowing towards the top.
- 30 12. A cascade scrubber according to patent claim 1, **characterized in that** the innermost chamber (16) of the droplet separation unit is connected to the discharge tube (11) of pure, dry gas.
13. A cascade scrubber according to patent claim 1, **characterized in that** the equipment functions in a reduced pressure.

09-01-2002

14. A cascade scrubber according to patent claim 1, **characterized in that** the scrubber is essentially cylindrical at the gas scrubbing unit and droplet separation unit and conical at the lower section.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00834

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC7: B01D 47/02**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC7: B01D**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**SE,DK,FI,NO classes as above**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SE 340333 B (AB BAHCO VENTILATION), 15 November 1971 (15.11.71), page 2, line 4 - line 13, figure 1  --	1-3
Y	US 5178653 A (LAUNO L. LILJA ET AL), 12 January 1993 (12.01.93), column 5, line 25 - line 27, figures 1-6B, abstract  --	1-3
A	SE 179714 B (AB BAHCO), 26 June 1962 (26.06.62), figures 1,2, claims 1-4  --	1-15
A	US 2687780 A (F.R. CULHANE), 31 August 1954 (31.08.54), figures 1-8, claim 1  --	1-15

 Further documents are listed in the continuation of Box C. See patent family annex.

- \* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

21 December 2000

Date of mailing of the international search report

15 -01- 2001

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. + 46 8 666 02 86Authorized officer  
  
Ulf Nyström/MP  
Telephone No. + 46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00834

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CH 464863 A (AB BAHCO), 31 December 1968 (31.12.68), figure 1, claim 1  -- -----	1-15

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
SE	340333	B	15/11/71	NONE	
US	5178653	A	12/01/93	AU 652617 B AU 1380992 A CA 2066090 A DE 69201587 D,T DK 509521 T EP 0509521 A,B SE 0509521 T3 FI 87541 B,C FI 911899 D	01/09/94 22/10/92 20/10/92 13/07/95 06/06/95 21/10/92 15/10/92 00/00/00
SE	179714	B	26/06/62	NONE	
US	2687780	A	31/08/54	NONE	
CH	464863	A	31/12/68	BE 661014 A DE 1240045 B DK 124924 B FI 42066 B FR 1428714 A GB 1090042 A	01/07/65 00/00/00 11/12/72 02/02/70 09/05/66 00/00/00

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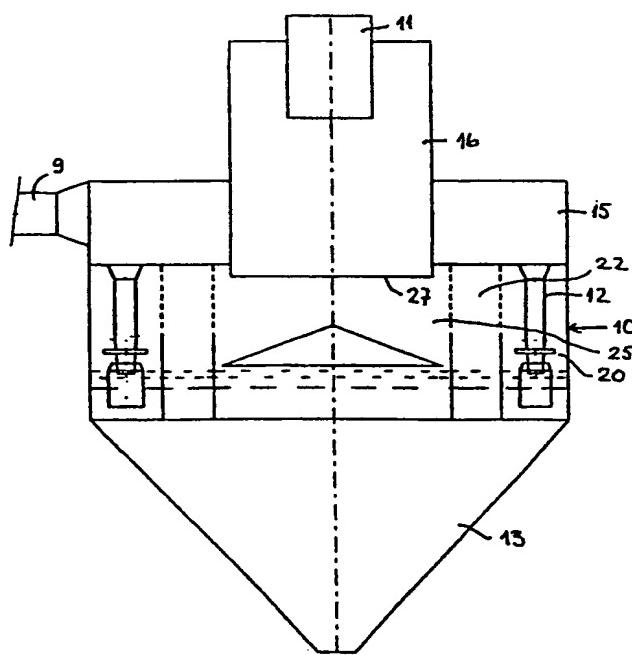
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A COMPACT CASCADE SCRUBBER FOR SCRUBBING EXHAUST GAS



(57) Abstract: This invention relates to a cascade-type scrubber, with which the wet scrubbing of the exhaust gas and removal of droplets from the gas can be performed in one and the same scrubber, producing a pure, dropless gas. It is thus essential that the cascade tubing typical of the cascade scrubber and the equipment for droplet removal are combined into a single compact entity, which is formed of several nested chambers.

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